PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2002-054408

(43)Date of publication of application : 20.02.2002

(51)Int.Cl. F01L 1/34

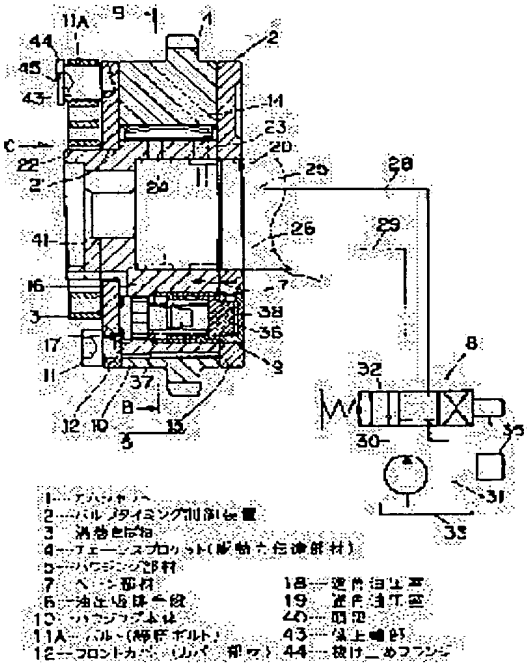
(21)Application number : 2000-245453

(22)Date of filing : 14.08.2000

(71)Applicant : UNISIA JECS CORP

(72)Inventor : SAITO MASAHARU
WATANABE KOTARO
HIDAKA AKIRA

(54) VALVE TIMING CONTROL DEVICE FOR INTERNAL COMBUSTION ENGINE



(57)Abstract:

PROBLEM TO BE SOLVED: To securely lock an end part of a spiral spring to a housing member without causing an increase of the number of part items, or an extreme increase of machining cost in the case of using the spiral spring having a flat cross section for energizing a vane member in the lead angle direction or a lag angle direction relative to the housing member.

SOLUTION: A lock shaft part 43 is provided on a head part of a fastening bolt 11A protruded from a front cover 12, and the end part of the spiral spring 3 is locked to the locking shaft part 43. Since tightening force of the bolt 11A does not reach the end part of the spiral spring 3, deformation is not generated at the end part of the spiral spring 3. The end part of the spiral spring 3 is locked by utilizing the head part of the bolt 11A for coupling a housing main body 5 with the front cover 12 and a rear cover 13, nonconformity such as an increase of the number of part items is not generated.

[Claim(s)]

[Claim 1] The driving force transfer member driven with an internal combustion engine's crankshaft, The cam shaft which is attached so that the relative rotation of said driving force transfer member can be carried out if needed while it has a drive cam for operating an engine valve on a periphery, and power is transmitted and carries out follower rotation from said driving force transfer member, The housing member which unites with said driving force transfer member and either of the cam shafts, and is rotated, The vane member which holds in said housing member, unites with said driving force transfer member and another side of a cam shaft, and is rotated, The tooth-lead-angle oil pressure room and lag oil pressure room which it is prepared [room] in said housing member and rotate said vane member with oil pressure, The oil pressure pumping means which is open for free passage in said tooth-lead-angle oil pressure room and a lag oil pressure room, and carries out pumping of the oil pressure to these oil pressure rooms alternatively, The spiral spring of the flat cross section which energizes said vane member in the direction of a tooth lead angle, or the direction of a lag to a housing member, The approximately cylindrical housing body with which a preparation and said housing member surround **** of a vane member, In an internal combustion engine's valve timing control unit constituted by the tabular covering member combined with the end face of this housing body with the conclusion bolt in alignment with shaft orientations While stopping the member which rotates the edge inside [direction of path] said spiral spring to a vane member or it, and one The valve timing control unit of the internal combustion engine characterized by having prepared the stop shank in the head of the conclusion bolt which projects from the edge of said covering member, and making this stop shank stop the edge of the direction outside of a path of said spiral spring.

[Claim 2] The valve timing control unit of the internal combustion engine according to claim 1 characterized by having escaped at the edge of the side estranged from the covering member of the head of said conclusion bolt, and preparing a stop flange.

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the valve timing control unit for controlling the closing motion timing of an internal combustion engine (it shall be hereafter called "engine") inlet valve or an exhaust valve according to a service condition.

[0002]

[Description of the Prior Art] By carrying out rotation actuation of the installation angle of driving force transfer members which carry out synchronous rotation with an

engine crankshaft, such as a timing pulley and a chain sprocket, and the cam shaft which has a drive cam on a periphery, the valve timing control unit which carries out adjustable control of the closing motion timing of an inlet valve or an exhaust valve is invented conventionally, and this technique is indicated by JP,10-68306,A etc.

[0003] A valve timing control unit given in this official report While attaching in the edge of a cam shaft at one the vane member equipped with two or more wing section which projects on the direction outside of a path and carrying out hold arrangement of said vane member inside a driving force transfer member and the housing member of one Establish a tooth-lead-angle oil pressure room and a lag oil pressure room in the interior of this housing member, and a vane member is relatively rotated to a housing member by carrying out pumping of the oil pressure to each of this oil pressure room alternatively. The rotation phase of a driving force transfer member and a cam shaft is changed by that cause, and the closing motion timing of an inlet valve or an exhaust valve is changed.

[0004] Moreover, the spring member which energizes a vane member in the direction of a tooth lead angle or the direction of a lag to a housing member is prepared in this valve timing control device, and it enables it to control an engine valve by energization by this spring member to predetermined closing motion timing at the time of engine starting etc. Although what wound the twist spring of a circular cross section around the plane, the spiral spring of a flattened section, etc. are used as a spring member which energizes a vane member, what wound the twist spring of a circular cross section around the plane is inferior in endurance, when the same torque constant compares to the spiral spring of a flattened section, and does not bear practical use. Moreover, the whole equipment enlarges and is not desirable when a number of turns is made [many], without stress's becoming large at the time of a torque constant and actuation, having to stop having to set up greatly the pump oil pressure for the part actuation, and changing a wire size, when a wire size is made thick, in order to raise endurance. From such a reason for a thing, use of the spiral spring of current and a flattened section is considered.

[0005] Moreover, while making a vane member and the slot of the cam-shaft sleeve which really rotates stop the edge inside [direction of path] this spring as attachment structure of a spiral spring in the case of the above-mentioned valve timing control device, the thing which made the height really formed in the side attachment wall of a housing member stop the edge of the direction outside of a path of this spring is adopted.

[0006]

[Problem(s) to be Solved by the Invention] However, when making the height formed in the housing member at one stop a spiral spring like this valve timing control device,

even if formation of a height is difficult in practice and is able to form, another faults, such as increase of a manufacturing cost, are produced.

[0007] That is, although sufficient reinforcement which can bear the torque of a spiral spring is secured when the lack of on the strength is caused, without the ability of a height bearing the torque of a spiral spring when a height is formed in a housing member and one by sintering and a height is formed in a housing member and one with forging, in order to have to spend many efforts on finish-machining after forging, the jump of a manufacturing cost is caused as a result.

[0008] Therefore, although forming in another object as a height which stops the edge of a spiral spring rather than forming in a housing member at one, ****ing behind, and attaching by a stop etc. is considered, since it leads to the jump of the part manufacturing cost which components mark increase in this case, an improvement of this point is desired now.

[0009] When it applies to installation of the spiral spring of a flattened section as it is, the edge of a spring deforms and it becomes impossible in addition, to acquire a desired property, although it can realize when this technique uses the twist spring of a circular cross section, although the technique of ******(ing) the edge of a twist spring with the conclusion bolt for fixing the body section of a housing member and a covering member is indicated by JP,3-185204,A.

[0010] Then, it is going to offer the valve timing control unit of the internal combustion engine which can make a housing member stop the edge of a spiral spring certainly, without causing the increment in components mark, the jump of processing cost, etc., when using the spiral spring of a flattened section for this invention energizing a vane member in the direction of a tooth lead angle, or the direction of a lag to a housing member.

[0011]

[Means for Solving the Problem] In order to solve this technical problem invention according to claim 1 The driving force transfer member driven with an internal combustion engine's crankshaft, The cam shaft which is attached so that the relative rotation of said driving force transfer member can be carried out if needed while it has a drive cam for operating an engine valve on a periphery, and power is transmitted and carries out follower rotation from said driving force transfer member, The housing member which unites with said driving force transfer member and either of the cam shafts, and is rotated, The vane member which holds in said housing member, unites with said driving force transfer member and another side of a cam shaft, and is rotated, The tooth-lead-angle oil pressure room and lag oil pressure room which it is prepared [room] in said housing member and rotate said vane member with oil pressure, The oil pressure pumping means which is open for free passage in said tooth-lead-angle oil

pressure room and a lag oil pressure room, and carries out pumping of the oil pressure to these oil pressure rooms alternatively, The spiral spring of the flat cross section which energizes said vane member in the direction of a tooth lead angle, or the direction of a lag to a housing member, The approximately cylindrical housing body with which a preparation and said housing member surround **** of a vane member, In an internal combustion engine's valve timing control unit constituted by the tabular covering member combined with the end face of this housing body with the conclusion bolt in alignment with shaft orientations While stopping the member which rotates the edge inside [direction of path] said spiral spring to a vane member or it, and one, a stop shank is prepared in the head of the conclusion bolt which projects from the edge of said covering member, and it was made to make this stop shank stop the edge of the direction outside of a path of said spiral spring.

[0012] Since the edge of the direction outside of a path of a spiral spring is stopped by the stop shank of the head of a bolt in this invention, the conclusion load of a bolt stops acting on a spiral spring.

[0013] It escapes from invention according to claim 2 at the edge of the side estranged from the covering member of the head of said conclusion bolt, and it prepared the stop flange.

[0014]

[Embodiment of the Invention] Next, 1 operation gestalt of this invention is explained based on a drawing.

[0015] In drawing 1 , 1 is the cam shaft of an engine exhaust side. While this cam shaft 1 is supported free [rotation] through bearing by the cylinder head outside drawing, the drive cam outside drawing for opening and closing the exhaust valve as an engine valve is prepared in that radical management periphery. The valve timing control unit 2 concerning this invention is formed in the end side of this cam shaft 1.

[0016] The chain sprocket 4 as a driving force transfer member by which the rotation drive of the valve timing control device 2 is carried out with a crankshaft through a timing chain (not shown), The housing member 5 by which this chain sprocket 4 was formed in the peripheral face at one, Said cam shaft 1 attached so that this housing member 5 could rotate if needed in the end section, The vane member 7 which was attached to one by the end of this cam shaft 1, and was held in the interior of said housing member 5 free [rotation], The oil pressure pumping means 8 to which forward inverse rotation of this vane member 7 is carried out with oil pressure according to engine operational status, It has a rotation regulation means 9 to regulate fluctuation of the vane member 7 accompanying the rotation fluctuation torque which acts on said cam shaft 1, and the spiral spring 3 of the flattened section which energizes the vane member 7 in the direction of a tooth lead angle to the housing

member 5.

[0017] Said housing member 5 equips the peripheral face with the disc-like front cover 12 (tabular covering member) and disc-like rear cover 13 which were combined with two or more bolts 11A and 11 by the end face before and behind the approximately cylindrical housing body 10 with which said chain sprocket 4 was formed in one, and this housing body 10, and as shown in drawing 2 , four bridge walls 14 of cross-section trapezoidal shape protrude on the inner skin of the housing body 10 at intervals of about 90 degrees.

[0018] On the other hand, said vane member 7 equips the approximate circle column-like drum section 16 and the peripheral face of this drum section 16 with the four wing sections 17 which protruded on the radial, a drum section 16 is arranged in the axial center location of the housing member 5, and each wing section 17 is arranged between the bridge wall 14 with which the housing member 5 adjoins, and 14. And it is made into the tooth-lead-angle oil pressure room 18 between the bridge walls 14 which stand face to face against the side face of one side of each wing section 17 of the vane member 7, and it, and is made into the lag oil pressure room 19 between the bridge walls 14 which stand face to face against the side face of the other side of each wing section 17, and it. Therefore, in this equipment, a total of 4 sets of pairs of the tooth-lead-angle oil pressure room 18 and the lag oil pressure room 19 is prepared.

[0019] Moreover, the boss section 22 which the vane member 7 penetrates the feed hole 21 of a front cover 12 while the crevice 20 where fitting of the edge of a cam shaft 1 is carried out is formed in the rear-face side of a drum section 16, and projects ahead is formed in the front-face side of a drum section 16. And said each tooth-lead-angle oil pressure room 18 and direction hole 23 of the 1st path which opens the inside of a crevice 20 for free passage, and the direction hole 24 of the 2nd path which opens the inside of said each lag oil pressure room 19 and crevice 20 for free passage are formed in a drum section 16, and each direction holes 23 and 24 of a path are open for free passage in the condition that fitting of the edge of a cam shaft 1 was carried out to the crevice 20, respectively to the 1st pumping hole 25 and the 2nd pumping hole 26 of a cam shaft 1. The vane member 7 and the cam shaft 1 are combined with the bolt which penetrates the axial center section of the drum section 16 of the vane member 7 and which is not illustrated.

[0020] It has two oil pressure paths, the 1st oil pressure path 28 which said oil pressure pumping means 8 is connected to the 1st pumping hole 25, and carries out pumping of the oil pressure to the tooth-lead-angle oil pressure room 18, and the 2nd oil pressure path 29 which is connected to the 2nd pumping hole 26 and carries out pumping of the oil pressure to the lag oil pressure room 19, and the supply path 30 and

the drain path 31 are connected to both these oil pressure paths 28 and 29 through the solenoid operated directional control valve 32 for a path change-over, respectively. The oil pump 34 which feeds the oil in an oil pan mechanism 33 is formed in said supply path 30, and the edge of the drain path 31 is open for free passage in said oil pan mechanism 33. Moreover, although a solenoid operated directional control valve 32 is controlled by the controller 35, the various signals which show engine operational status are inputted into this controller 35.

[0021] On the other hand, the rotation regulation means 9 is what locks mechanically relative rotation of the housing member 5 and the vane member 7 when rotation control of the vane member 7 is carried out at the tooth-lead-angle side at the time of engine starting etc. The lock pin 36 hold support of the attitude of was enabled in accordance with shaft orientations at the one wing section 17 of the vane member 7, The spring member 37 which energizes this lock pin 36 in the protrusion direction (rear cover 13 direction), It has been arranged in the setting location of the medial surface of a rear cover 13, and the tip of a lock pin 36 is equipped with the lock hole 38 by which fitting is carried out in the location which the vane member 7 displaced to the tooth-lead-angle side to the housing member 5 at max. In addition, the pars basilaris ossis occipitalis of the lock hole 38 is open for free passage in the lag oil pressure room 19, and the oil pressure of the lag oil pressure room 19 acts on the point at the time of fitting of a lock pin 36.

[0022] Moreover, said spiral spring 3 is arranged at the front-face side of a front cover 12, and while the edge of the direction inside of a path is stopped by the boss section 22 of the vane member 7 projected from the front cover 12, the edge of the direction outside of a path is stopped by the head 40 of bolt 11A of the special configuration shown in drawing 5 . In accordance with radial, a slit 41 is formed in the boss section 22 of the vane member 7, and insertion engagement of the crookedness edge inside [direction of path] a spiral spring 3 is carried out at this slit 41.

[0023] On the other hand, although bolt 11A has the shank 42 by which penetrates a front cover 12, and a stop is ****ed and carried out to the housing body 10 and a rear cover 13 like other bolts 11, and said head 40 adjacent to the front face of a front cover 12 The omission stop flange 44 jutted out over the direction outside of a path in the tip of the stop shank 43 of a cross-section circle configuration with die length long a little and this stop shank 43 rather than the width of face of a spiral spring 3 is formed in this head 40. In addition, 45 is the hexagon socket for tool engagement formed in the head end face of bolt 11A.

[0024] Moreover, the hook section 46 of the letter of the abbreviation for U characters is formed in the edge of the direction outside of a path of a spiral spring 3, and this hook section 46 is engaging with the stop shank 43 of said bolt 11A. Here, a

spiral spring 3 energizes the vane member 7 in the direction of a tooth lead angle by the resiliency of the extension direction, and the relative turning effort over the housing member 5 as shown by the arrow head F in drawing 2 is acting on the vane member 7.

[0025] In this structure, if high-pressure hydraulic oil is supplied to the tooth-lead-angle oil pressure room 18 by actuation of a solenoid operated directional control valve 32, the energization force of a spiral spring 3 is also helped, the vane member 7 will displace in the maximum tooth-lead-angle location to the housing member 5, and the rotation driving force inputted into the housing member 5 with the condition will be transmitted to a cam shaft 1 through the vane member 7. An exhaust valve will be opened and closed by this to tooth-lead-angle timing.

[0026] In addition, when the vane member 7 displaces in the maximum tooth-lead-angle location to the housing member 5, a lock pin 36 engages with the lock hole 38 of the housing member 5, and the vane member 7 is mechanically locked to the housing member 5.

[0027] Moreover, if the lag oil pressure room 19 is open for free passage from this condition to the supply path 30 with actuation of a solenoid operated directional control valve 32 and the tooth-lead-angle oil pressure room 18 comes to be open for free passage to the drain path 31, with the high-pressure hydraulic oil introduced into the lag oil pressure room 19, the vane member 7 will resist the energization force of a spiral spring 3, it will displace in the maximum lag location, and rotation driving force will be transmitted to a cam shaft 1 through the vane member 7 with that condition. An exhaust valve will be opened and closed by this to lag timing.

[0028] In this way, in case the vane member 7 tends to displace in a lag location from a tooth-lead-angle location, in order that the high-pressure hydraulic oil introduced into the lag oil pressure room 19 may act on the pars basilaris ossis occipitalis of the lock hole 38, a lock pin 36 retreats at this time, and mechanical association of the vane member 7 and the housing member 5 is canceled.

[0029] The housing member 10 can be made to stop the edge of a spiral spring 3 certainly, although this valve timing control device 2 operates as mentioned above, without causing the increment in components mark, since the housing member 5 is made to stop the edge of the direction outside of a path of a spiral spring 3 using conclusion bolt 11A of the housing body 10 and a front cover 12. And since the stop shank 43 formed in the head 40 of bolt 11A is made to stop the edge of the direction outside of a path of a spiral spring 3, the fault which the clamping force of bolt 11A does not reach the edge of a spiral spring 3, therefore causes deformation to the edge of a spiral spring 3 is not produced.

[0030] Moreover, since it escapes on the head 40 of bolt 11A and the stop flange 44 is

formed in it with the stop shank 43 with which the hook section 46 of a spiral spring 3 engages, the valve timing control device of this operation gestalt can prevent certainly that the edge of a spiral spring 3 falls out from the stop shank 43 by this flange 44. Furthermore, since the both ends of the cross direction of the hook section 46 fall out with a front cover 12 and contact the stop flange 44 when a twist tends to arise at the edge of a spiral spring 3, twist deformation of the edge of a spiral spring 3 can also be controlled certainly.

[0031] In addition, although the case where the valve timing control unit concerning this invention was formed in the edge of the cam shaft of an exhaust side was explained above, the same configuration can be adopted also when preparing in the edge of the cam shaft of an inspired air flow path. However, in applying to an inspired air flow path, the energization direction of the vane member by the spiral spring turns into the direction of a lag.

[0032]

[Effect of the Invention] Invention according to claim 1 can aim at reduction of components mark, and reduction of processing cost as mentioned above, without producing fault, like the conclusion load of a bolt acts on a spiral spring, and causes deformation, in order to make the stop shank of the head of a bolt stop the edge of the direction outside of a path of a spiral spring.

[0033] In being able to escape from omission from the stop shank of the edge of a spiral spring and being able to prevent certainly by the stop flange, it can escape from invention according to claim 2, and it can also control twist deformation of a spiral spring by the stop flange and the covering member.

[Brief Description of the Drawings]

[Drawing 1] The sectional view which meets the A–A line of drawing 2 which shows 1 operation gestalt of this invention.

[Drawing 2] The sectional view which meets the B–B line of drawing 1 which shows this operation gestalt.

[Drawing 3] C view Fig. of drawing 1 showing this operation gestalt.

[Drawing 4] The perspective view of a front cover showing this operation gestalt.

[Drawing 5] The side elevation of the conclusion bolt in which this operation gestalt is shown.

[Description of Notations]

1 — Cam shaft

2 — Valve timing control unit

3 — Spiral spring

4 — Chain sprocket (driving force transfer member)

5 -- Housing member

7 -- Vane member

8 -- Oil pressure pumping means

10 -- Housing body

11A -- Bolt (conclusion bolt)

12 -- Front cover (covering member)

18 -- Tooth-lead-angle oil pressure room

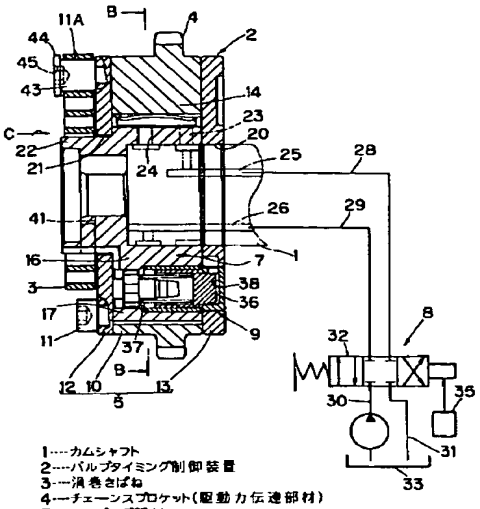
19 -- Lag oil pressure room

40 -- Head

43 -- Stop shank

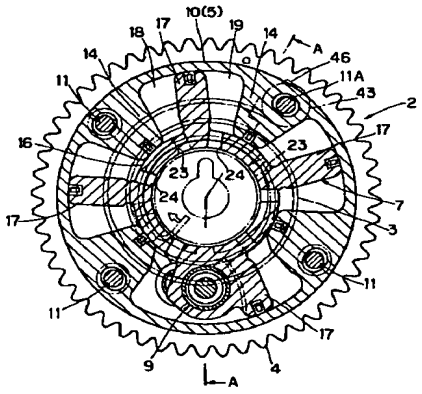
44 -- It escapes and is a stop flange.

[Drawing 1]

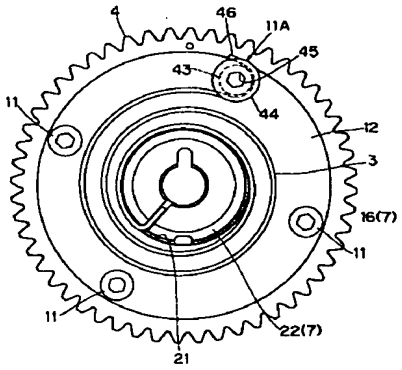


1----カムシャフト
2----バルブタイミング制御装置
3----渦巻きばね
4----チェーンスプロケット(駆動力伝達部材)
5----ハウジング部材
7----ベーン部材
8----油圧吸排手段
10----ハウジング本体
11A----ボルト(締結ボルト)
12----フロントカバー(カバー部材)
18----進角油圧室
19----遅角油圧室
40----溝部
43----係止凹部
44----抜け止めフランジ

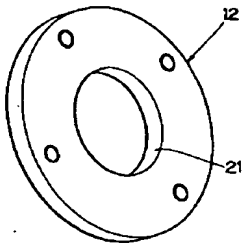
[Drawing 2]



[Drawing 3]



[Drawing 4]



[Drawing 5]